Building a Community of Learners within the STEM Higher Education Classroom

Shaun Nykvist[1] and Michelle Mukherjee[1]
[1]Queensland University of Technology
s.nykvist@qut.edu.au

Abstract: *Building rich and authentic learning experiences in the STEM classroom, is a challenge for many educators within Higher Education. While many Higher Education Institutions have embraced the need to transform current teaching and learning practices and include a range of online tools, this has often been met with some resistance and approaches that do not always recognise the academic who are a critical component to the success of the transformational process. Over the last decade the Internet has evolved from being a tool used by a few dedicated educators to one that is being used by the majority of educators. However, what is important is how this great resource is used in teaching and learning to allow students to build knowledge. The ability for students to construct knowledge and engage in higher order thinking skills is at the heart of educational practices, and building a community of learners has the potential to support these practices, especially within STEM education. This paper explores the relationship between students and an academic teaching in a technology rich STEM learning environment and their adoption of social community and shared tools. In particular the paper reports on the critical components that make a successful community of learners and the educational tools and approaches that were successfully used to enhance the student learning experience in a STEM classroom.*

Keywords: STEM, Science, BYOD, portable mobile devices, Higher Education teaching and learning, Community of Learners

1. Introduction

Academics teaching within the area of STEM, in Higher Education Institutions, are continually looking for ways to better connect and engage with students in meaningful ways. At the same time, many institutions are currently looking at ways in which they can transform current teaching and learning practices and are allocating large budgets to ensure change happens at a broader systemic level, especially when it comes to the development of massive online open courses (MOOCs) (see Yuan & Powell, 2013). With the plethora of online tools and teaching approaches available to educators the task of selecting and correctly using the many tools and approaches can be quite daunting. It is within this context that this paper will explore the notion of a community of learners and how a variety of learning approaches and tools were used with N=19 students in a core Space and Earth unit. While the unit is quite small it does give the academic the opportunity to experiment with a range of tools and teaching approaches, with an emphasis on building a community of learners. This paper reports on a research project that is a work in progress.

The use of the terminology associated with communities and learning is quite vast and well developed with many shared similarities. In many instances researchers and educators use the terminology synonymously even though they can be described and defined in different ways. Some common terminology includes:

- Communities of learners (see Brown & Campione, 1990)
- Knowledge building communities (Scardamalia & Bereiter, 1992)
- Communities of practice (CoP)(Lave & Wenger, 1991)
- Online learning communities (Brown, 1999)
- Internet based learning communities (IBLC) (Wolf, 2001)

Despite the differences in terminology, there are some basic similarities in the ways that these communities operate and are very valid as we attempt to transform the higher education scene. Savery and Duffy (1995) suggest that these commonalities include:

a. Complex, challenging learning environments with authentic tasks;
b. Social negotiation and shared responsibility as a part of learning;
c. Multiple representations of content;
d. Understanding that knowledge is constructed;
e. Student centred instruction.

These learning communities can exist in a physical face-to-face (f2f) mode, an online or virtual mode, or a hybrid mode (more commonly referred to as blended) and students tend to seamlessly move between both the physical and online communities. The challenge for educators in higher education institutions is knowing how to build and scaffold appropriate learning experiences for students in these communities given the range and availability of online tools, mobile devices and social media technologies (SMT). This is important as higher education is transformed at all levels and more and more students are connected with their own devices. Similarly, familiarity and ease of use of the chosen online tools also needs to be taken into account – some purpose built online education tools can be quite daunting to some users.

2. Methodology and Theoretical Framework

This project is underpinned by a social constructivist perspective on the enactment of curriculum (cf. Goodson, 1996). Goodson argues that that "the definition of subject knowledge that precedes interactive negotiation and redefinition in the classroom… must be studied in its own right" (1996, p.4) in order to become more aware of how curriculum delivery is constructed by factors such as personal attitudes and institutional practices. In this project the 'preactive' stage of the curriculum is framed as the space in which institutions develop policies, practitioners seek out (or don't seek out) professional learning, and both students and staff test out new technologies to establish their potential to support and enhance learning outcomes. The 'active' stage of the curriculum is framed as the current learning and teaching practices undertaken in higher education, as identified in the data.

The broad methodological orientation of this research can be described as informed by the epistemology of grounded theory (Corbin & Strauss, 2008), which is used as a framework for identifying core concepts relating to online tools to support communities of learners in higher education settings. Consistent with the aim to identify good practice approaches derived from the research data, grounded theory attempts to link a general methodology of analysis with "data collection that uses a systematically applied set of methods to generate an inductive theory about a substantive area" (Glaser & Strauss, 1967). It is for this reason that this project does not seek to isolate any single area of curriculum or course design for analysis. Instead the

researchers will analyse data in search of persistent themes and core concepts that emerge from participants' responses in relation to issues of content, course delivery, pedagogy and student support.

This small case-based pilot study draws upon the popularity and accessibility of online tools and the plethora of available teaching approaches, as well as the student uptake of mobile and portable devices being used by many students and some academics, to identify the best match use of online tools and pedagogical approaches used to connect and engage with students to form a community of learners. The students (N=19) in the study were undergraduate education students enrolled in a first year space and earth unit. A wide range of "interconnected interpretive practices" (Denzin & Lincoln, 2000, p.3) were utilised to identify the use of mobile devices and social media technologies by students and staff (e.g., surveys, individual and focus group interviews, video and photographic observations, narratives) to elucidate rich and meaningful data. Qualitative data will be analysed using a grounded theory approach to coding response content (Corbin and Strauss, 2008).

3. Results and Discussion

The results presented here report on the initial research outcomes of the research project, but provide a good basis for building early recommendations about the research project. The results are based on the survey data, classroom observations and initial interviews. The survey results obtained an overall 52% response rate with detailed written responses given in all text fields. In building a community of learners it was important to understand how students used ICT and connected with each other in every day life so that better informed decisions can be made about the use of online tools to support the learners in the classroom. The results indicated that all students (100%) were familiar with using ICT, they frequently used it for communicating in social ways (e.g. facebook, instagram) and they all owned a minimum of 1 mobile device with 90% owning a smart phone as well as a tablet computer and a laptop or computer. All students also indicated on the survey that they saw the importance of using online tools and mobile devices to support science education and that the would use these tools in their science classrooms when they became teachers. One student responded by saying that

> *"ICT is ubiquitous and exists in many forms in the world at large, so at a broad level, ICT belongs in all classrooms in a variety of forms to provide access and familiarity to students as early as possible. Specifically within the science classroom, mobile computing gains many advantages from portability. Apps such as google sky, google goggles and camera apps are not viable on desktop computers, and can all be harnessed within a science classroom" (Student A).*

While this response indicated the use of mobile tools to interact and engage with, a further response indicated that *"Mobile devices can be used to create and record experiments and information and calculate results"* (student B), hence reinforcing the ability to collect, collate and interpret scientific data. Drawing on the results of the initial survey a number of learning experiences were developed to support the teaching and learning experiences in the classroom. These included the use of authoring software for students to create their own epub or ibook in groups throughout the nominated lecture and tutorial times, the development of an external support forum where students and lecturer could anonymously develop high level discussion and argumentation, digital storytelling practices to be used in groups and the focused use of students own tablets (iPad or android based tablets) to engage students with content applications and authoring software.

The analysis of the interviews with students indicated the importance of them being able to use their own devices and their overwhelming positive response to not having traditional lecture based classes. They welcomed the variety of activities and the ability to socially interact online and in person with each other with 100% of students forming Facebook groups to develop their group presentations. In the interviews one student indicated that they were also participating in a MOOC on space theory and had found that useful in supporting what they were doing in this particular unit of work.

Building a community of learners is not about merely placing digital artefacts such as documents or presentations or even video and audio online for the student to consume. Furthermore, placing this within a learning management system (LMS) with a common interface also does not equate to building an active online community where knowledge building will occur. Too often LMS's are used for the transmission of content in higher education and do not allow students to build knowledge or engage in higher order thinking skills. Many of the LMS's also measure how many times students access resources but again this does not mean students are actively engaged in the learning process. Some MOOCs fall into a similar habit of placing content online for the student to consume and adding a few quizzes and peer review assessment items, but not actually engaging the student in an active online community where students can co-construct knowledge. The students in this small research study have indicated that they felt more connected and engaged with not just the content, but also with their peers and the wider learning community, through their online and face2face conversations.

In transforming higher education and embracing the strength of a community of learners, it is essential to choose tools that are the most appropriate for what you are trying to achieve and best suited to students being actively involved in co-constructing knowledge in a particular domain. There is no one size fits all for every possible topic of study or even experience that you wish the student to be a part of. It is possible that a combination of tools is best suited to a particular learning experience (but be careful not too use too many and confuse students). There is a need to identify what the intended purpose of the community is and how it will work as well as understanding the background of your students.

For example, if we decide a discussion forum is the tool we need as part of our online community, then it needs to be more then the posting of a link for discussion or asking a series of questions (which would essentially result in similar responses). It should allow students to co-construct knowledge and encourage rich dialogue where students can propose a solution or explanation to an event or problem, provide evidence to substantiate their explanation or solution, and allow them to evaluate the feedback given to them by other individuals. There are a number of learning approaches that can be applied within online communities and this particular example is based on the notion of argumentation.

4. Conclusion

A connected and engaged community of learners doesn't just happen and doesn't always work in the intended way, however, it does allow educators to rethink their approaches to teaching and learning and to create environments that are both collaborative and social in nature. Students need to have a reason to be part of an online community and it needs to go beyond that of a linked assessment item. Likewise, academics need to be given the time to effectively manage their online community and to provide scaffolding where

necessary, as well as understanding which tools are most appropriate for their students and the unit objectives or outcomes.

Some common online tools, activities and social media technologies that could support online communities if used in the correct way include blogs, google communities, facebook groups, discussion forums, wikis, twitter, pinterest, online collaboratively built digital story telling, storify, instagram and tumblr. This is not an exhaustive list of tools and approaches but gives some idea of where to start the transformation process in higher education when developing an online community.

References

Brown, A., & Campione, J. (1990). Communities of learning and thinking, or a context by any other name. In D. Kuhn (Ed.), Developmental perspectives on teaching and learning thinking skills (Contributions to Human Development Series) (pp. 108-126)). Basle, Karger.

Brown, M. E. (1999). Beyond the first wave: A framework for online learning. Journal of Online Learning, 11(1), 15-21

Corbin, J., & Strauss, A. (2008). Basics of qualitative research: Techniques and procedures for developing grounded theory (3rd ed.). Thousand Oaks, CA: Sage.

Denzin, N. K., & Lincoln, Y. S. (2005). Introduction: The discipline and practice of qualitative research. In N. K. Denzin& Y. S. Lincoln (Eds.), The Sage handbook of qualitative research (2nd ed.), (pp. 1-32). Thousand Oaks, CA: Sage

Glaser, Barney G & Strauss, Anselm L., (1967). The discovery of grounded theory: Strategies for qualitative research, Chicago, Aldine Publishing Company

Goodson, I. (1996). Studying school subjects: A guide. London: Routledge.

Hillery, G. (1955). Definitions of community: Areas of agreement. Rural Sociology, 20(2), 111-123

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. New York: Cambridge University Press.

Scardamalia, M., & Bereiter, C. (1992). Text-based and knowledge-based questioning by children. Cognition and Instruction, 9(3), 177-199

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. Educational Technology, 35, 31-38.

University of Adelaide (2012). *iPad information* retrieved from http://www.sciences.adelaide.edu.au/current/firstyear/info_ipad.html on 10/07/2012.

Wolf, K. D., (2001). Internet Based Learning Communities: moving from patchwork environments to ubiquitous learning infrastructures. In S. Dijkstra, D. Jonassen and D. Sembil (Eds.) Multimedia Learning: Results and Perspectives. Frankfurt am Main, Germany: Peter Lang.

Yuan, Li and Powell, Stephen, (2013) MOOCs and Open Education: Implications for Higher Education in JISC CETIS. March 2013. Retrieved from http://publications.cetis.ac.uk/2013/667